Master's Thesis Engineering Technology

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The effects of printer settings and infill on the dosimetry of three-dimensional printed phantoms with tissue and bone equivalent filaments

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Problem and objective

Patient specific quality assurance is difficult to assure when the only available phantoms are for the average human. This is why NuTeC, the Nuclear Technology Centre, associated with UHasselt, is looking into ways to 3D print patient specific phantoms with tissue equivalent filaments for both soft tissue and bone. This thesis aims to study the influence of printer settings and infill types on the dosimetry of these 3D printed phantom.

Method

Creation of 3D models based on a patient's CT data using 3D Slicer.

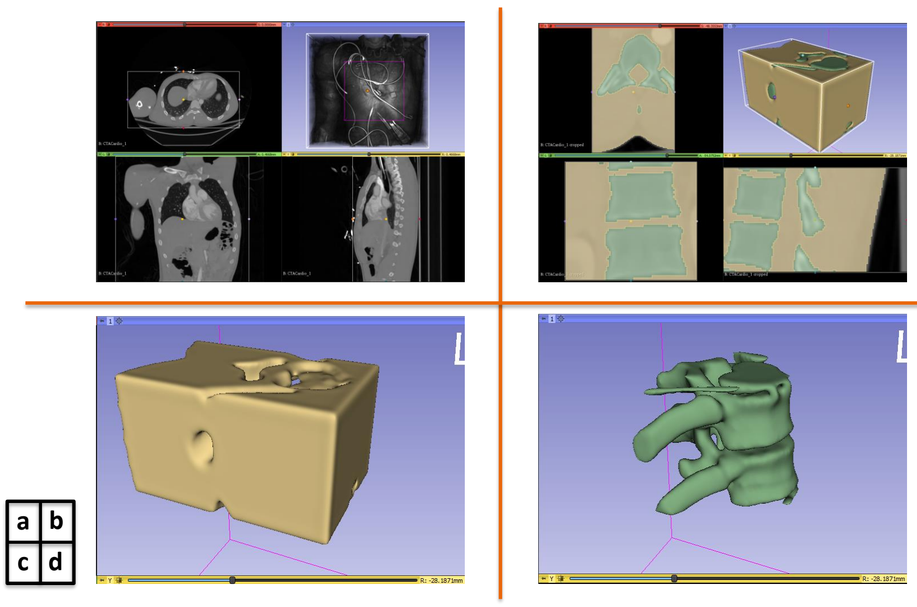

Figure 1-4: (a) patient CT data, (b) segmentations, (c) and (d) 3D models

Irradiation of 36 samples 3D printed at MAASTRO clinic. Measurement of the delivered dose using film dosimetry.

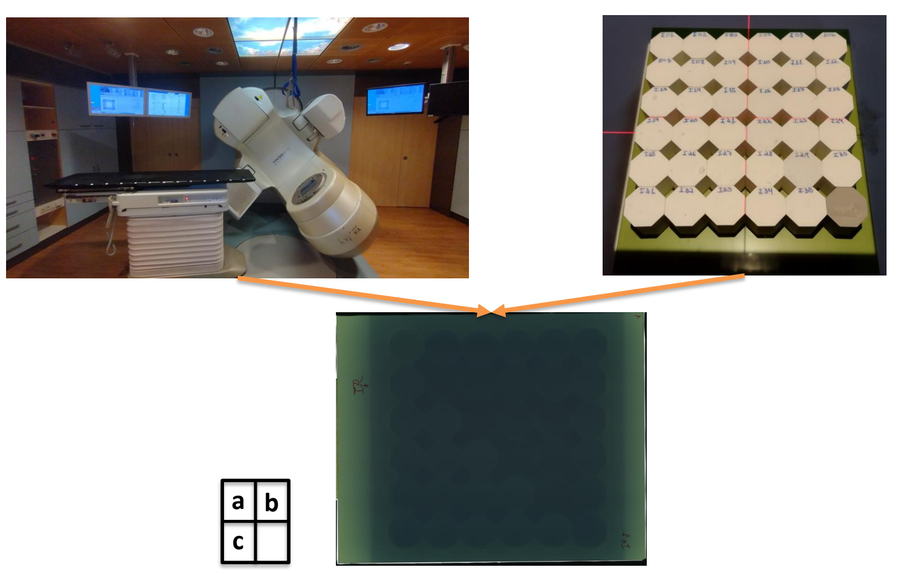

Figure 5-7: (a) Varian TrueBeam linac "Evian", (b) samples placed on film, (c) film after irradiation

Results

Using an Epson 10000XL scanner the irradiated films were scanned and dose maps for different orientations of the samples were generated using FilmQA Pro. These dose maps were statistically studied and profiles were drawn for analysis.

Figure 8: Dose map

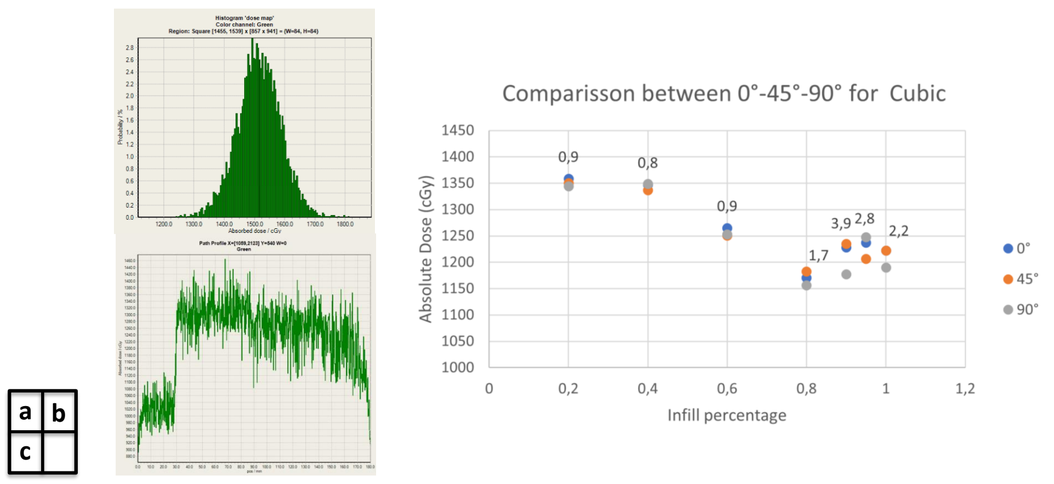

Figure 9-11: (a) Examples of a histogram for the centre of one sample, (b) comparison between orientations 0°, 45°, and 90° for the cubic infill, (c) profile drawn through the samples

Conclusions

Based on the statistical analysis and the profiles drawn through the samples, the cubic infill type was chosen to produce the most consistent 3D printed phantoms for one particular tissue. By making use of 3D slicer the generation of a 3D model based on a patient's CT data is possible. Further research in printer settings and tissue to filament equivalence is recommended.

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